messages. The Specification further teaches, and certain of the Claims embrace various other aspects of the method including: a method suitable for and practiced on a multiprocessor computer with the processing of agents shared among the multiple processors; a method of transferring messages well-suited for efficient operation on a multiprocessor computer; methods where agents can learn from past decisions by modifying their decision rules; and specific decision rules and internal state organization for specific agents.

SUMMARY OF THE ART

Leijonhufvud contains a general discussion of various economic principles and methods of analysis. *Leijonhufvud* does not teach any modeling or computer-based prediction of economic behavior. *Leijonhufvud* mentions multiprocessor computers as a metaphor for decentralized decision-making in an economy (in contrast to a single processor representing a central planner), but does not mention any implementation, computer or otherwise, of the general economic principles discussed. *Leijonhufvud* uses the term "agents" to describe decision-makers, but has no mention of software-defined agents as the term is defined in the present application.

"Microsimulated Transactions Model" (hereafter *Bennett*) describes a limited economic model. *Bennett's* model limits each decision-maker to a single action per week, and does not accommodate simultaneous actions. *Bennett's* model is further limited to single-firm representations of industry. *Bennett* has no mention of agent action responsive to messages, agent generation of messages, multiprocessor implementation, message passing methods, agent learning, or specific decision rules and internal state organization.

OBVIOUSNESS

Applicants respectfully submit that the Office has not made a *prima facie* case supporting an obviousness rejection of Claims 1-8 and 10-15. A *prima facie* case of obviousness requires, *inter alia*, that the prior art reference or references teach or suggest all the claim limitations. *See* MPEP 2143. Applicants submit that the art relied on by the Office does not teach or suggest all the limitations in Claims 1-8 and 10-15, as discussed in detail below. Accordingly, Applicants urge that Claims 1-8 and 10-15 are in condition for allowance.

Claim 1: Message-based agent communication

Leijonhufvud has no teaching or suggestion of any implementation of a method for prediction based on the general theories described. *Bennett* has no teaching or suggestion of message-based agent communication, as specifically recited in steps a), c)i), and c)ii) of Claim 1. *Bennett* specifically acknowledges limitations to a single action per week, and no modeling of simultaneous actions. In contrast, the present invention, through the use of software-defined agents with internal state and decision rules and message-based communication, can accurately model multiple actions per agent, and can accurately model simultaneous actions.

Since the art, alone or in combination, does not teach or suggest the limitation in Claim 1 of message-based agent communication, Applicants submit that a *prima facie* case of obviousness of Claim 1 has not been made. Accordingly, Applicants urge that Claim 1 is in condition for allowance.

Claims 2-8 and 11-15 depend from and further define the invention of Claim 1. Accordingly, Claims 2-8 and 11-15 are also in condition for allowance. *See* MPEP 2143.03; *In re Fine*, 837 F.2d 1071 (Fed. Cir. 1988).

Claim 2: Claim 1 plus multiprocessor operation

Claim 2 depends from Claim 1, and additionally recites the limitation to practice of the method of Claim 1 on a multiprocessor computer and the additional step of assigning each processor a subset of the agents to process. *Bennett* has no mention of multiprocessor operation or assignment of agents to processors. Further, *Bennett's* method is not suitable for multiprocessor operation because it does not accommodate simultaneous actions. Lacking simultaneous actions, practice of *Bennett's* method on a multiprocessor would not achieve any benefit since the processors could not operate in parallel. *Leijonhufvud* mentions multiprocessor computers as a metaphor for decentralized decision-making in an economy, but has no teaching or suggestion of representing decision-makers in software and assigning and processing those agents on a multiprocessor computer. While the Office asserts that "it would have been obvious ... to have used a multiprocessor configuration", the only teaching or suggestion of a multiprocessor application according to the present invention is found in Applicants' application.

Since none of the art, alone or in combination, teaches or suggests the limitations in Claim 2 to practice of the method of Claim 1 on a multiprocessor computer and the additional step of assigning each processor a subset of the agents to process, Applicants submit that a *prima facie* case of obviousness of Claim 2 has not been made. Accordingly, Applicants urge that Claim 2 is in condition for allowance.

Claim 5 depends from and further defines the invention of Claim 2. Accordingly, Claim 5 is also in condition for allowance. *See* MPEP 2143.03; *In re Fine*, 837 F.2d 1071 (Fed. Cir. 1988).

Claim 3: Claim 1 plus agent learning

Claim 3 depends from Claim 1, and additionally recites the limitation of modifying an agent's decision rules during processing of the agent. Modifying an agent's decision rules allows an agent to learn from results associated with past decisions, important to accurate prediction of real economies. *See* Application pages 10-11. Neither *Bennett* nor *Leijonhufvud* have any teaching or suggestion of agent learning, or of the specific method recited in Claim 3 (changing an agent's decision rules during processing of the agent). While the Office asserts that "it would have been obvious to have modified decision rules", the only teaching or suggestion of such modified decision rules is found in Applicants' application.

Since none of the art, alone or in combination, teaches or suggests the limitation in Claim 3 of modifying an agent's decision rules during processing of the agent, Applicants submit that a *prima facie* case of obviousness of Claim 3 has not been made. Accordingly, Applicants urge that Claim 3 is in condition for allowance.

Claims 4, 6-8, and 11-15 depend from and further define the invention of Claim 3. Accordingly, Claims 4, 6-8, and 11-15 are also in condition for allowance. *See* MPEP 2143.03; *In re Fine*, 837 F.2d 1071 (Fed. Cir. 1988).

Claim 4: Claim 3 with a specific method of agent learning

Claim 4 depends from Claim 3, and additionally recites the limitation of a specific method for modifying an agent's decision rules during processing of the agent. The specific method recited was found by the Applicants to be beneficial in conjunction with the rest of the invention. *See* Application pages 10-11. Neither *Bennett* nor *Leijonhufvud* have any teaching or suggestion of

agent learning, or of the specific method recited in Claim 4 (representing probability of an action by a probability vector and adjusting the probability vector based in results of past actions). While the Office asserts that "it would have been obvious to have modified decision rules by probability vectors", the only teaching or suggestion of such modified decision rules is found in Applicants' application.

Since none of the art, alone or in combination, teaches or suggests the limitation in Claim 4 of modifying an agent's decision rules by representing probability of action by a probability vector and adjusting the probability vector based in results of past actions, Applicants submit that a *prima facie* case of obviousness of Claim 4 has not been made. Accordingly, Applicants urge that Claim 4 is in condition for allowance.

Claim 5: Claim 2 with specific message routing steps

Claim 5 depends from Claim 2, and additionally recites the limitation of specific steps for routing messages. The specific steps recited were found by the Applicants to be beneficial in promoting efficient practice of the present invention on a multiprocessor computer. *Bennett* has no mention of multiprocessor operation or assignment of agents to processors. Further, *Bennett's* method is not suitable for multiprocessor operation because it does not accommodate simultaneous actions. Lacking simultaneous actions, practice of *Bennett's* method on a multiprocessor would not achieve any benefit since the processors could not operate in parallel. *Leijonhufvud* mentions multiprocessor computers as a metaphor for decentralized decision-making in an economy, but has no teaching or suggestion of representing decision-makers in software and assigning and processing those agents on a multiprocessor computer. While the Office asserts that "it would have been obvious to have grouped message for efficiency", the only teaching or suggestion of message-based agent communication using grouped messages is found in Applicants' application.

Since none of the art, alone or in combination, teaches or suggests the limitation in Claim 5 of specific message routing steps, Applicants submit that a *prima facie* case of obviousness of Claim 5 has not been made. Accordingly, Applicants urge that Claim 5 is in condition for allowance.

Claims 6-8: Claim 3 plus specific decision rules and internal state organization

Claims 6-8 depend from Claim 3, and additionally recite the limitation of specific decision rules and internal state organization for specific agents. Neither *Bennett* nor *Leijonhufvud* have any teaching or suggestion of the specific decision rules and internal state organizations recited in Claims 6-8.

Since none of the art, alone or in combination, teaches or suggests the limitations in Claim 6-8 of specific decision rules and internal state organization for specific agents, Applicants submit that a *prima facie* case of obviousness of Claims 6-8 has not been made. Accordingly, Applicants urge that Claims 6-8 are in condition for allowance.

Claim 9

Claim 9 has been canceled.

Claim 10: Message-based agent communication plus multiprocessor operation

Leijonhufvud has no teaching or suggestion of any implementation of a method for prediction based on the general theories described. *Bennett* has no teaching or suggestion of message-based agent communication, as specifically recited in steps d), e) and f) of Claim 10. *Bennett* specifically acknowledges limitations to a single action per week, and no modeling of simultaneous actions. In contrast, the present invention, through the use of software-defined agents with internal state and decision rules and message-based communication, can accurately model multiple actions per agent, and can accurately model simultaneous actions.

Claim 10 additionally recites the limitation to practice of the method on a multiprocessor computer and the additional step of assigning each agent to at least one processor. *Bennett* has no mention of multiprocessor operation or assignment of agents to processors. Further, *Bennett's* method is not suitable for multiprocessor operation because it does not accommodate simultaneous actions. Lacking simultaneous actions, practice of *Bennett's* method on a multiprocessor would not achieve any benefit since the processors could not operate in parallel. *Leijonhufvud* mentions multiprocessor computers as a metaphor for decentralized decision-making in an economy, but has no teaching or suggestion of representing decision-makers in software and assigning and processing those agents on a multiprocessor computer. While the

Office asserts that "it would have been obvious ... to have used a multiprocessor configuration", the only teaching or suggestion of a multiprocessor application according to the present invention is found in Applicants' application. Further, the only teaching or suggestion of message-based agent communication is found on Applicants' application.

Since none of the art, alone or in combination, teaches or suggests the limitations in Claim 10 of message-based agent communication, and the limitation to practice of the method on a multiprocessor computer and the additional step of assigning each processor a subset of the agents to process, Applicants submit that a *prima facie* case of obviousness of Claim 10 has not been made. Accordingly, Applicants urge that Claim 10 is in condition for allowance.

Claim 11: Claim 7 plus agent learning

Claim 11 depends from Claim 7, and additionally recites the limitation of modifying an agent's decision rules during processing of the agent. Modifying an agent's decision rules allows an agent to learn from results associated with past decisions, important to accurate prediction of real economies. *See* Application pages 10-11. Neither *Bennett* nor *Leijonhufvud* have any teaching or suggestion of agent learning, or of the specific method recited in Claim 11 (changing an agent's decision rules during processing of the agent). While the Office asserts that "it would have been obvious to have modified decision rules", the only teaching or suggestion of such modified decision rules is found in Applicants' application.

Since none of the art, alone or in combination, teaches or suggests the limitation in Claim 11 of modifying an agent's decision rules during processing of the agent, Applicants submit that a *prima facie* case of obviousness of Claim 11 has not been made. Accordingly, Applicants urge that Claim 11 is in condition for allowance.

Claims 13-15: Claim 12 plus specific decision rules and internal state organization

Claims 13-15 depend from Claim 12, and additionally recite the limitation of specific decision rules and internal state organization for specific agents. Neither *Bennett* nor *Leijonhufvud* have any teaching or suggestion of the specific decision rules and internal state organization recited in Claims 13-15.

Since none of the art, alone or in combination, teaches or suggests the limitations in Claim 13-15 of specific decision rules and internal state organization for specific agents, Applicants submit that a *prima facie* case of obviousness of Claims 13-15 has not been made. Accordingly, Applicants urge that Claims 13-15 are in condition for allowance.

CONCLUSION

Applicants have responded to each and every rejection and urge that the Claims as presented are now in condition for allowance. Applicants request expeditious processing to issuance.

Respectfully submitted,

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CERTIFICATION UNDER 37 CFR 1.8

I hereby certify that this correspondence and documents referred to herein were deposited with the United States Postal Service as first class mail addressed to: Assistant Commissioner for Patents, Washington, DC 20231 on the date shown below.

Date: 10/30/98 By: Marilyn Dahl